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Blood Pressure Level and Mortality Among Men*

MORTALITY is higher among people whose blood pressure is above average than among those whose blood pressure is average or lower; generally, the higher the level of blood pressure the greater is the excess mortality. New data on the relation of systolic and diastolic pressures to mortality are available from the Build and Blood Pressure Study, 1959, by the Society of Actuaries; the investigation is based upon the records of men who, after medical examination, were accepted for Life insurance either as standard or as substandard risks. Apart from elevated blood pressure, these men were either free of impairment or had only such minor impairments as would not bar them from obtaining standard insurance.

Table 1 shows the mortality ratios among men according to age at issue and blood pressure level. Data are presented only for those cases where both the associated systolic and diastolic readings are above average for the insured, except that in a few cases among men over age 50, the systolic reading was in the range of average pressures. For each combination of readings in this table, the mortality ratio exceeds that for all standard risks, which is taken as 100 percent. For each age group, the mortality ratios show a pronounced upward trend with increase in either the systolic or diastolic level, and more rapidly with elevation in both. For example, at issue ages 40-49 the mortality ratio for men with systolic blood pressures of 128-137 mm. increases from 139 percent among those with diastolic pressures of 83-92 mm. to 263 percent among those with diastolic pressures of 98-102 mm. Similarly, at the same ages, the mortality ratio for men with diastolic pressures of 93-97 mm. rises from 156 percent among those with systolic pressures of 128-137 mm. to 319 percent among those with systolic pressures of 158-177 mm. In interpreting the results shown in Table 1, account must be taken of the more careful

*This is the eighth of a series of articles dealing with major findings and implications of the *Build and Blood Pressure Study, 1959*, recently published by the Society of Actuaries. This investigation covered the experience of several million people insured by 26 large Life insurance companies in the United States and Canada during the period 1935-53.

selection of risks with greater elevations of blood pressure. This may explain in part the exceptions to the general upward trend in the mortality ratios with increase in elevation of blood pressure.

For like blood pressure levels, the mortality ratios are generally higher for the younger than for the older men. Thus, among men with systolic pressures of 138-147 mm. and diastolic pressures of 83-92 mm., the mortality ratio decreases from 198 percent at issue ages 30-39 to 149 percent at issue ages 50-59. This finding is not surprising in view of the larger proportion of men with elevated blood pressures at the older ages. Because of this larger proportion, the extent of departure from the average blood pressure for the systolic and diastolic groups shown in the table is relatively smaller for the older men.

The study gives clear evidence that blood pressures which are somewhat below average are associated with lowest mortality. To illustrate, at issue ages 30-59 the

TABLE 1—MORTALITY OF MEN WITH ABOVE-AVERAGE BLOOD PRESSURE
By Age at Issue, Ages 30-59

Men Accepted for Ordinary Insurance in 1935-53
Traced to Policy Anniversary in 1954

Age at Issue; Diastolic Pressure†	Systolic Pressure (mm.)			
	128-137	138-147	148-157	158-177
	Mortality Ratio (Percent)*			
Ages 30-39				
83- 92 mm.	144	198	221	‡
93- 97	240	249	261	‡
98-102	‡	277	498	‡
Ages 40-49				
83- 92 mm.	139	180	229	282
93- 97	156	200	294	319
98-102	263	225	358	313
Ages 50-59				
83- 92 mm.	114	149	194	224
93- 97	163	199	208	265
98-102	‡	201	196	304

*Mortality ratio for all persons in each age group insured as standard risks=100 percent.

†Fifth phase: auscultatory reading taken at the point of complete cessation of sound.

‡Fewer than 35 deaths in this category.

Note: These data relate to standard and to substandard risks as a group, and include risks with and without minor impairments.

Source: Derived from *Build and Blood Pressure Study, 1959*, Society of Actuaries.

TABLE 2—MORTALITY FROM SELECTED CAUSES AMONG MEN WITH ABOVE-AVERAGE BLOOD PRESSURE
Ages 15-69 at Issue
Men Accepted for Ordinary Insurance in 1935-53
Traced to Policy Anniversary in 1954

Degree of Elevated Blood Pressure†	Mortality Ratio (Percent)*				
	Heart and Circulatory Diseases	Vascular Lesions, Central Nervous System	Nephritis	Diabetes	Digestive Diseases
Moderately elevated					
Systolic or diastolic	138	155	154	105	136
Systolic and diastolic	180	243	273	158	149
Markedly elevated					
Systolic or diastolic	209	300	263	224	172
Systolic and diastolic	282	616	472	‡	193

*Mortality from specified causes for all persons insured as standard risks=100 percent.

†Moderately elevated: systolic pressure of 138-147mm.; diastolic pressure of 83-92mm. Markedly elevated systolic pressure of 148-177mm.; diastolic pressure of 93-102mm. Diastolic readings at fifth phase: auscultatory reading taken at the point of complete cessation of sound.

‡Fewer than 35 deaths in this category.

Note: These data relate to standard and to substandard risks as a group, and include risks with and without minor impairments.

Source: Derived from *Build and Blood Pressure Study, 1959*, Society of Actuaries.

mortality ratio is approximately 75 percent of standard for men with systolic blood pressure of 98-127 mm. and diastolic pressures of 48-67 mm.

The excess mortality among men with elevated blood pressure is attributable largely to the cardiovascular-renal diseases. Not only do these diseases record a higher death rate among men with above-average blood pressure than among standard risks but, more important, they account for a large majority of the total death toll. As may be seen in Table 2, the mortality ratio from the heart and circulatory diseases among men with moderately elevated systolic or diastolic blood pressure is 138 percent; the mortality ratio rises to 282 percent for men with marked elevation in both systolic and diastolic pressures. Even greater is the ratio for vascular lesions of the central nervous system (chiefly cerebral hemorrhage), which is more than six times as high among men with markedly elevated blood pressure as among standard risks. Nephritis, accounting for a relatively small proportion of the deaths, also shows a high mortality ratio among men with markedly elevated blood pressure, probably reflecting the association of renal disorders with

hypertension.

The mortality ratios from diabetes are also generally high; this is in line with clinical findings, which show a considerable frequency of hypertension in diabetics. The digestive diseases likewise show a higher mortality among men with elevated blood pressure than among standard risks.

The findings of the Build and Blood Pressure Study, 1959, are in complete accord with previous insurance investigations. Consistently, they indicate that even relatively modest elevations in blood pressure, as reported at the time of insurance examination, tend to be associated with significantly excess mortality. The underlying reasons for this increased mortality and the means for its control ultimately rest on new information derived from continued basic research on the mechanisms involved.

Continued Growth of School Population

THE school-age population of the United States has been increasing steadily since the close of World War II and is expected to continue rising in the foreseeable future. The indications are that the number of children at ages 5-17 years will grow from 45 million this year to 53 million in 1970, and may reach 59 million by 1980. In other words, about 14 million children will be added to our population of elementary and high-school age in the next two decades—a gain of almost a third. This expected growth reflects largely the record high number of births throughout the postwar years and their anticipated continuation at a relatively high level. Estimates of our future school-age population are shown in the accompanying table.

Although the elementary schools have already experienced a marked increase in enrollments, the rise will persist in the years ahead. This is evident from the figures for children 5-13 years of age, the period of life when almost all boys and girls attend school. During the next five years, the number of children in this age group is expected to reach new high levels, increasing an average of about one-half million annually to 36¼ million in 1965. The subsequent trend will, of course, depend on the number of children born in our country in the years to come. However, the outlook is for continued *small* increases in the number of children aged 5-13 until the mid-1970's and *marked* increases thereafter. By 1980, this group of children may number 42½ million, one fourth more than at present.

In the past few years, the registers in high schools have been expanding at a faster rate than those for elementary schools, and this

PROJECTION OF SCHOOL-AGE POPULATION, UNITED STATES, 1960-1980

Year (July 1)	Number in Millions			Percentage Increase Over 1960		
	Ages 5-17	Ages 5-13	Ages 14-17	Ages 5-17	Ages 5-13	Ages 14-17
1960.....	45.05	33.79	11.26			
1961.....	46.19	34.03	12.16	3	1	8
1962.....	47.64	34.68	12.96	6	3	15
1963.....	49.05	35.28	13.77	9	4	22
1964.....	50.41	35.86	14.55	12	6	29
1965.....	50.63	36.23	14.40	12	7	28
1966.....	51.17	36.57	14.60	14	8	30
1967.....	51.68	36.79	14.89	15	9	32
1968.....	52.20	36.90	15.30	16	9	36
1969.....	52.60	36.96	15.64	17	9	39
1970.....	52.99	37.04	15.95	18	10	42
1975.....	54.54	38.05	16.49	21	13	46
1980.....	59.02	42.51	16.51	31	26	47

Note: Figures relate to the 50 States, including the Armed Forces overseas, and are consistent with Series III projections published by the Bureau of the Census in *Current Population Reports*, P-25, No. 187.

trend will continue during the 1960's. Thus, the number of children of high school age, those 14-17 years, will climb from 11¼ million this year to 14½ million by the mid-1960's, and further to 16 million by the close of the decade. This means that the population at the high school ages will grow by 42 percent within the next 10 years, whereas the comparable increase for children of elementary school age will be only 10 percent. Moreover, the rise in high school enrollments will undoubtedly be even greater than that indicated by the forthcoming growth of the population aged 14-17, since an increasing proportion of children are continuing their formal education through high school and beyond. Currently, about 91 percent of the children at ages 14-17 are enrolled in school; by 1970, the proportion may reach 95 percent. At the same time, higher education is gaining in popularity, with the result that the number of college graduates in our population may rise from about 8 million to almost 11 million a decade hence.

Elementary and high school enrollments will continue to rise to new peaks in most sections of the country, but the increases will be especially marked in areas where there has been a large influx of population. This will be particularly true in the West and in suburban communities throughout the

country, which have been attracting families with young children.

It is clear that for many years to come the United States will be confronted with the problem of providing adequate educational facilities and personnel for a rapidly increasing school population. It is vital to the welfare of the American people that these needs be met.

Focal Points of the Motor Vehicle Accident Problem

MOTOR vehicle accidents continue to take a heavy toll of life, despite the fact that they are largely amenable to control and that extensive safety programs have been directed against them. In 1957, the motor vehicle accident death rate in the United States—23 per 100,000 population—was no lower than it was in 1949-50. While the death rate from this cause among males was 34 per 100,000 in both periods, among females it rose from 10 to 11.

Every geographic division of the country suffers a large loss of life from motor vehicle accidents, as may be seen in Table 1. The highest mortality rates are found among residents of the western and southwestern areas of the country. Thus, in 1957, the rate among residents of the Mountain States was 32 per 100,000, or nearly 1½ times that for the country as a whole. The rate was 28 per 100,000 in the West South Central States and almost as high in the Pacific States. Residents of the Northeast, on the other hand, recorded the lowest rates. In New England the motor vehicle accident death rate—12 per 100,000—was little more than half the national figure, and in the Middle Atlantic States it was about 16 per 100,000.

In every geographic division, more than one fifth of the deaths from motor vehicle accidents occur in the age group 15-24 years; as Table 1 shows, in the East South Central States the proportion is at least one fourth. The age pattern of mortality varies, however, from one geographic area to another. In the Northeast, people at ages 65 and over account for 1 out of every 5 of the fatally injured, almost as large a proportion as at ages 15-24. In the North Central divisions and in the Pacific States the proportion of aged victims is not much lower. In the other areas of the United States, however, the number killed at ages 65 and over, broadly speaking, is half the number of fatally injured at ages 15-24. Geographic differences in the age distribution of deaths from motor vehicle accidents reflect differences in the age distribution of the populations and in the relative frequency of the various types of accident. As will be shown later, the age distribution

TABLE 1—GEOGRAPHIC VARIATION IN MORTALITY FROM MOTOR VEHICLE ACCIDENTS

By Age. General Population of the United States, 1957

Area	Number of Deaths	Death Rate per 100,000 Population	Percent Distribution of Deaths by Age								
			All Ages	Under 5	5-14	15-24	25-34	35-44	45-54	55-64	65 and Over
UNITED STATES—Total.	38,702	22.7	100.0	4.6	6.7	22.4	16.2	12.8	11.5	10.6	15.1
New England.....	1,212	12.3	100.0	4.2	7.7	24.2	12.7	9.2	11.1	10.3	20.5
Middle Atlantic.....	5,096	15.5	100.0	3.6	6.8	21.2	14.2	11.0	11.6	12.2	19.4
East North Central...	7,884	22.5	100.0	4.5	6.8	22.0	15.9	12.5	10.9	10.9	16.5
West North Central..	3,806	25.0	100.0	4.9	5.4	23.3	14.3	11.0	11.5	11.8	17.6
South Atlantic.....	6,035	24.4	100.0	5.1	7.6	22.8	19.0	14.4	11.0	8.6	11.4
East South Central...	3,060	25.9	100.0	4.2	7.4	25.6	17.7	13.3	11.2	9.3	11.3
West South Central..	4,631	28.4	100.0	5.6	7.1	21.6	16.7	14.0	12.2	10.7	12.0
Mountain.....	2,020	32.1	100.0	5.6	6.9	24.3	17.3	13.8	12.4	8.8	10.7
Pacific.....	4,958	27.0	100.0	4.2	5.4	20.6	16.0	13.6	12.1	11.4	16.6

Source of basic data: Reports of the National Office of Vital Statistics.

of the mortality among pedestrians is very different from that among occupants of motor vehicles.

To throw additional light on a focal point of the motor vehicle accident problem—the teen ages and early 20's—the Metropolitan Life Insurance Company made a special tabulation of the mortality among its Industrial policyholders for single years of age from 15 through 24 years; these rates, along with those for several broad age groups under age 75, are shown in Table 2. In 1958-59, the peak motor vehicle accident death rate among white male policyholders occurred at ages 21 and 22. The rate increased sharply from 7 per 100,000 boys at ages 1-14 to 66 at ages 21-22, and then fell abruptly, but was as high as 40 per 100,000 at ages 23 and 24, and did not drop below 25 for any of the older age groups shown in the table.

Among white female policyholders the motor vehicle accident death rate recorded a peak at age 18 — several years earlier than among males—and another at ages 65-74. In 1958-59, the death rate for females rose from about 4 per 100,000 at ages 1-14 to nearly 17 at age 18; the rate then decreased and remained at a lower level throughout the greater part of adult life, but rose again to about 18 per 100,000 at ages 65-74. The motor vehicle accident death rate was markedly higher for males than for females at every age group. At age 21 the ratio of the mortality was

TABLE 2—MORTALITY FROM MOTOR VEHICLE ACCIDENTS—TOTAL AND PEDESTRIAN
White Persons, by Sex, Ages 1-74 Years
Industrial Policyholders, Metropolitan Life Insurance Company, 1958-59

Age (Years)	White Males			White Females		
	Average Annual Death Rate per 100,000		Percent Pedestrian of Total	Average Annual Death Rate per 100,000		Percent Pedestrian of Total
	Total Motor Vehicle	Pedestrian		Total Motor Vehicle	Pedestrian	
1-74	24.2	4.7	19	8.3	1.9	23
1-14	7.1	3.9	55	3.8	2.1	55
15	14.9	2.5	17	9.8	1.2	12
16	29.6	3.0	10	9.8	0.3	3
17	37.5	2.6	7	14.6	0.6	4
18	51.0	2.4	5	16.6	1.0	6
19	61.7	1.5	2	10.5	0.3	3
20	54.6	1.6	3	10.2	1.2	12
21	66.3	4.2	6	10.0	0.5	5
22	66.4	2.9	4	11.3	0.5	4
23	40.2	1.9	5	8.3	0.6	7
24	40.0	2.0	5	10.8	0.6	6
25-29	35.0	2.0	6	6.1	0.4	7
30-64	25.4	4.8	19	8.2	1.4	17
65-74	37.5	19.0	51	17.6	7.2	41

6⅔ to 1, and was not much lower at the adjacent ages. At ages 1-74 combined, the motor vehicle accident death rate among males was 3 times that among females.

Table 2 shows also that fatal injuries to pedestrians account for only about one fifth of the motor vehicle accident mortality in this insurance experience. Moreover, deaths among pedestrians are largely concentrated at the childhood and the older ages. At ages 1-14, where the proportion of such deaths is highest, they account for little more than half of all motor vehicle accident fatalities. However, in the aggregate, the occupants of motor vehicles—drivers and passengers—constitute the majority of victims. Among white males in this experience, drivers and passengers comprised more than 90 percent of the total motor vehicle mortality at ages 17 through 29; the experience for females is not appreciably different from that among males.

Mortality Higher This Year

THE death rate among Industrial policyholders of the Metropolitan Life Insurance Company was 3 percent higher in the first half of 1960 than in the like period of last year, the rates for all ages combined being 7.2 and 7.0 per 1,000, respectively. The increase reflects largely the relatively high level of mortality in the late winter months. In February the death rate was 11 percent above that for the month a year ago; in March the increase amounted to 15 percent.

Both white male and female policyholders recorded slightly higher death rates in the first half of this year than last, as the accompanying table shows. In general, the death rates tended downward or remained unchanged prior to age 35; there was some contrary tendency at the older ages.

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MORTALITY FROM ALL CAUSES FIRST SIX MONTHS OF 1960 AND 1959

White Industrial Policyholders by Sex
Metropolitan Life Insurance Company

Age Period (Years)	Death Rate per 1,000			
	White Males		White Females	
	1960*	1959	1960*	1959
Under 75	7.8	7.6	5.4	5.3
Under 5	1.3	1.6	1.0	1.1
5- 9	0.4	0.5	0.3	0.3
10-14	0.4	0.5	0.3	0.3
15-19	0.9	1.0	0.4	0.4
20-24	1.2	1.3	0.5	0.6
25-34	1.4	1.7	0.7	0.9
35-44	4.1	3.5	1.9	1.9
45-54	10.9	11.1	4.8	4.6
55-64	26.3	25.7	11.8	12.1
65-74	57.9	56.3	32.7	32.6

*Provisional.

For the first six months of 1960, the death rate from pneumonia and influenza in this insurance experience was 28.3 per 100,000, or about one third above that in the corresponding period of 1959, and the highest in more than a decade. In February and March the mortality from these diseases was almost twice that a year ago.

The cardiovascular-renal diseases recorded a moderately higher death rate in the first half of this year than last. As the table on page 11 shows, the rate rose from 378.4 to 386.3 per 100,000. For the most part, the increase represents the elevated level of mortality from these diseases in the early months of the year. Only a small increase is found in the death rate from cancer (malignant neoplasms) through June—from 144.9 to 146.7 per 100,000. Currently, nearly three fourths of the total mortality among the Industrial policyholders is attributed to cancer and the cardiovascular-renal diseases.

The tuberculosis death rate increased fractionally from the all-time low of 5.8 per 100,000 recorded in the first half of last year. Nevertheless, the current rate—6.2 per 100,000—is about one fourth below that prevailing five

years ago. The mortality from the principal communicable diseases of childhood — measles, scarlet fever, whooping cough, and diphtheria—continues to be extremely low.

There were only two deaths from poliomyelitis among the Industrial policyholders through June of the current year, compared with five in the like period of 1959. This is consistent with the trend of poliomyelitis cases reported in the general population of the United States. About 476 cases of the disease were reported in the first half of 1960, compared with 1,021 a year ago.

The accident death rate among the Industrial policyholders—32.1 per 100,000—is identical with that for the first six months of 1959. Motor vehicle accident fatalities, however, recorded a fractional decrease. Suicide tended downward so far this year while homicide increased slightly.

The Statistical Bureau of the Metropolitan Life Insurance Company keeps a current record of catastrophes—accidents in which five or more persons are killed. The facts for the general population of continental United States, compiled from a variety of sources, are briefly summarized here.

Catastrophic accidents took about 600 lives in the first half of 1960, considerably less than the toll in the comparable period of last year, and one of the lowest on record. Through June of this year there were four disasters in which 25 or more persons were killed, three of them involving scheduled aircraft. On January 6, a scheduled plane "disintegrated" in flight near Wilmington, N. C.—attributed to possible sabotage by dynamite—causing 34 deaths. Another scheduled plane crashed on January 18 southeast of Richmond, Va., with a loss of 50 lives, and a third exploded in flight near Tell City, Ind. on March 17, killing 63 persons—the heaviest toll so far this year. The remaining disaster was a series of tornadoes which smashed through eastern Oklahoma and Arkansas, on May 5, and accounted for 29 deaths, mostly in Oklahoma.

Catastrophic fires in dwellings and apartments killed only half as many people in the first six months of 1960 as in the like period of 1959. The record for catastrophic motor vehicle accidents was also relatively more favorable, except for collisions between motor vehicles and trains, which were responsible for a somewhat larger death toll than a year ago. Tornadoes and floods both caused a smaller loss of life this year than last.

MORTALITY FROM SELECTED CAUSES

Industrial Policyholders, Metropolitan Life Insurance Company
May and June 1960

Cause of Death	Annual Rate per 100,000 Policyholders*						
	May		June		First Six Months		
	1960†	1959†	1960†	1959†	1960†	1959†	1958
All Causes	690.0	679.8	649.9	664.2	718.9	698.1	702.8
Tuberculosis (all forms)	6.5	5.5	5.5	5.1	6.2	5.8	7.6
Communicable diseases of childhood	0.2	0.2	0.1	—	0.1	0.1	0.3
Acute poliomyelitis	—	—	—	0.1	‡	0.1	—
Malignant neoplasms	147.4	144.7	142.4	142.7	146.7	144.9	141.2
Digestive system	51.2	51.3	46.4	49.8	49.2	49.7	46.7
Respiratory system	22.5	18.9	22.0	21.0	22.0	21.5	20.0
Diabetes mellitus	14.4	16.5	13.6	18.6	16.5	16.1	16.8
Diseases of the cardiovascular-renal system	370.7	360.6	344.8	354.0	386.3	378.4	376.6
Vascular lesions, central nervous system	68.3	67.4	65.5	62.4	72.0	71.4	70.0
Diseases of heart	273.6	268.3	253.0	265.5	286.2	279.6	279.3
Chronic rheumatic heart disease	10.3	12.1	9.6	11.2	11.6	11.5	12.5
Arteriosclerotic and degenerative heart disease	218.7	210.7	204.9	209.6	229.2	221.9	220.2
Diseases of coronary arteries	128.6	124.5	122.8	125.4	134.0	132.4	125.1
Hypertension with heart disease	31.6	32.4	28.3	32.5	32.3	33.3	35.2
Other diseases of heart	13.0	13.1	10.3	12.2	13.0	12.8	11.4
Nephritis and nephrosis	6.9	7.5	7.2	6.4	7.3	7.5	8.1
Pneumonia and influenza	20.6	21.5	16.5	16.6	28.3	21.5	26.3
Complications of pregnancy, childbirth	0.6	0.3	1.1	0.4	0.7	0.7	0.9
Suicide	6.8	7.3	6.4	6.9	6.4	6.8	6.1
Homicide	2.8	2.6	2.0	2.4	2.9	2.7	3.0
Accidents—total	31.0	31.6	34.4	37.0	32.1	32.1	32.8
Motor vehicle	11.7	13.5	15.1	16.2	13.6	13.9	14.2
All other causes	89.0	89.0	83.1	80.4	92.7	88.9	91.2

*These death rates relate to persons insured under Weekly or Monthly premium-paying Industrial policies and Monthly premium-paying Ordinary policies for small amounts of insurance.

†Beginning with January 1959, deaths have been classified according to the Seventh Revision of the International List of Causes of Death. Consequently, the death rates for individual causes in 1959 and 1960 are not strictly comparable with those for earlier periods. Rates for 1960 are provisional.

‡Less than 0.05.

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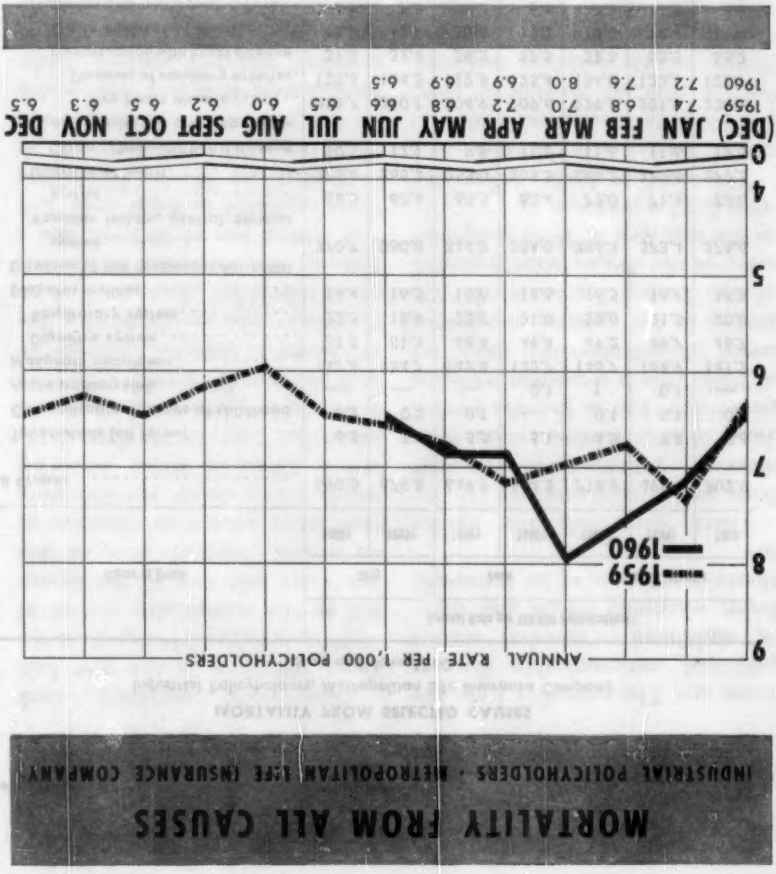

MORTALITY FROM ALL CAUSES

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